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M E E T I N G

Meteorite Impact and Volcanism

by

F. HÖRZ
The Lunar Science Institute
Houston, Texas

and

T. H. FOSS
NASA - Manned Space Craft Center
Houston, Texas

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A meeting on "Meteorite Impact and Volcanism" was sponsored by the Universities Space Research Association under NASA contract NSR-09-012-071 and held at the Lunar Science Institute, Houston, October 19 - 23, 1970. About 80 specialists in the areas of meteorite impact and volcanic phenomena met to bring their collective knowledge to bear on the exploration and interpretation of lunar surface phenomena. The following is a general summary of this meeting.

Aided by laboratory shock experiments, the shock features in naturally shocked tectosilicates can now be better correlated with the data from theoretical and experimental equation of state work. Thus the regimes of the various stages of shock metamorphism can be based on somewhat firmer P-T conditions. It was, however, convincingly demonstrated that dense crystalline rocks (granites, gneisses) behave drastically different from porous materials like Coconino Sandstone. In both rock types however coesite is never formed during the compressional state but always upon pressure release either directly from α quartz and/or from stishovite or a highly disordered high pressure phase. "Planar features" as well as shock produced solid state glasses are interpreted as highly disordered remnants of high pressure phases.

Returned lunar fines display abundant evidence of the important role of meteorite impact in forming the lunar regolith. The deformations observed in these materials seem to be exclusively shock-

induced. The vast majority of glasses is shock melted, although a small percentage of lunar glasses may represent primary pyroclastic material of volcanic origin. The preservation of delicate, highly fragile constituents in the fine-grained lunar breccias seems to preclude their formation by direct shock-lithification. Welding of individual components within a hot base surge cloud generated by meteorite impact was suggested as an alternative.

Structural aspects of impact craters such as formation of detailed rim structures and intense macro deformation of rocks were discussed. The ejecta blankets around natural and artificial impact sites as well as those around nuclear and large scale chemical and nuclear explosion craters display concentric distribution patterns and inverted stratigraphy. However detailed knowledge about the actual ejection — and deposition processes is lacking. The formation mechanism of central uplifts in impact craters remains controversial. However it was postulated that such structures are formed immediately after crater excavation either by gravitational slumping of the crater walls pushing the crater bottom upwards or as a rebound phenomenon closely associated with pressure release. Impact generated igneous rocks are found either at the very bottom of the crater or in an annulus on the outside slopes of the actual crater rim.

There is general agreement that the lunar surface rocks were originally formed by igneous processes (crystallization from magmas or lavas). The controversy continues over the extent to which impact

processes have modified or obliterated primary volcanic features. Many examples were presented of features that were interpreted as lava flows, calderas, and other typically volcanic landforms that have been only slightly modified by subsequent impacts.

The spatial relation between igneous rocks and specific cratering events seems to be well established and documented both in the terrestrial and lunar cases. The exact genetic relations are still the subject of considerable interpretation and controversy. For many lunar craters there seems to be some question of whether the melt was produced directly from the energy of the impact, melting surficial rocks, or that the melting is a secondary "volcanic" phenomenon "triggered" by pressure release, fracturing, etc. caused by the impact. In the case of the huge outpourings of lava that have flooded the mare basins, the problem is even more complex, and some workers contend that the only relation is a geometrical one in which genuine volcanic lavas have used impact-produced structures as basins of accumulation. Strong evidence was presented that the physical properties of lunar surface lavas would allow high mobility and would be capable of forming extensive thin sheets on surfaces of very low topographic gradient.

The meeting emphasized the fact that there exist wide areas of overlapping interest between those who pursue lunar surface problems from the impact point of view and those whose interests are in volcanic phenomena. It is clear that the combined talents of both

of these groups will be required to eventually arrive at an understanding of the processes that have resulted in the varied and complex features of the lunar surface.